The future design of renewable electricity auctions in Spain. A comment.

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Abstract

In its recently published draft on an Integrated National Energy and Climate Plan (PNIEC in its Spanish acronym), the Spanish government outlines the main elements of the design of RES-E auctions for the 2021-2030 period. The aim of this paper is to compare the design of the future auctions with past auctions in Spain (organized in 2016 and 2017) and with the international experiences, and to assess their advantages and drawbacks. In addition to effectiveness and minimization of support costs (which were also goals in the previous auctions), promotion of actor diversity and flexibility of dispatch are explicitly mentioned as government goals. It is found out that the main design choices of the future auctions, as envisaged in the PNIEC, entail a rupture with the auctions which were organized in the past in Spain. In general, they will be less complex and more aligned with the international experiences than the previous auctions. In particular, organizing auctions within a medium and long-term energy planning strategy and a multiannual schedule of auctions, auctioning and remunerating generation and not capacity and explicitly promoting technological and actor diversity imply a key departure with respect to previous auctions and are deemed appropriate choices. However, many details on the design elements are still unknown, as they will be provided in future pieces of legislation.

1. Introduction

Spain was traditionally regarded as a world-class model in the support of electricity from renewable energy sources (RES-E). This was so from the late 1990s until the solar PV boom in 2008, which led to a ten-fold increase in the total support costs for this technology and, then, to retroactive cuts and a moratorium on support in 2012. For years, no support scheme was applied. This situation ended up in January 2016, with the organization of two auctions for wind and biomass, followed by two more auctions in May and July 2017. 8700 MW, at a zero support level, were awarded in these three auctions. All the projects should be built by the end of 2019. However, in its recently published *Integrated Energy and Climate Change Plan* (PNIEC, in its Spanish acronym), the government outlines the main elements of the design of RES-E auctions in the 2030 timeframe, which involves substantial changes with respect to those with a 2020 horizon.

The aim of this paper is to compare the design of the future auctions with past auctions in Spain (organized in 2016 and 2017) and with the international experiences, and to assess their advantages and drawbacks. It is a common perception that the success of RES-E support in general and RES-E auctions in particular depends on the choice of design elements. And a given design is contingent upon several factors, including government goals at the time and the socioeconomic and institutional context in which auctions are adopted. Therefore, this paper adds to the literature by identifying such design and design context in a given setting, *i.e.,* Spain.

Accordingly, the paper is structured as follows. The next section provides a brief background on the features which influenced the design of the RES-E auctions in Spain, including institutional and socioeconomic features and government goals. Section 3 describes the main design elements envisaged for auctions in the 2021-2030 period, comparing them to previous auctions (in 2016 and 2017) and to the international experiences, and discussing their advantages and drawbacks. Section 4 concludes.

2. Background: context and goals of RES-E auctions in Spain

Auctions for RES do not stand in a vacuum. They are an instrument to meet government goals, rather than an end in themselves. And they coexist with other instruments, with which they interact in complementary, synergistic or conflicting ways. They are adopted in a given socioeconomic, institutional and technological context and are thus partly conditioned by it. Therefore, when discussing auction design, such broader context in which auctions are implemented, including the goals of the government when designing them, should be taken into account.

In addition to structural characteristics of the Spanish electricity market/system, the design of the 2016-2017 auctions was influenced by a still high tariff deficit, relatively high retail prices, the need to comply with the 2020 RES targets and the very particular features of the Spanish electricity law (Law 413/2014)(see del Río, 2016, 2017a). Spain is basically an electricity island with limited interconnections with other countries and has had a considerable overcapacity in electricity generation (del Río and Janeiro 2016). In 2012, the government established a moratorium on RES-E and, since then, only 1800 MW were added until 2015, of which 1000 MW corresponded to large hydro and only 281 and 129 MW to wind and PV, respectively. In 2015, there were 51749 MW of renewable energy installed capacity, including large hydro. In other words, the additions between 2012 and 2015 represented 3% of the total installed capacity in 2015. However, the country had a comparatively high penetration of RES and, at the time, it was in a good compliance path with its 2020 RES targets (20% in 2020).[1]

Retail electricity prices were higher than the EU average and the country was hard hit by a deep economic crisis.[2] The tariff deficit, the large increase in the costs of RES-E support and a sluggish electricity demand in the context of a deep economic crisis were the factors leading the government to stop support for new RES-E installations in 2012 (see the explanatory memorandum of Royal Decree Law 1/2012)(del Río 2017a). The Renewable Energy Plan (PER) 2011-2020 aims to achieve a penetration of RES of 20.8% of gross energy consumption by 2020 (a share of 39% of total electricity consumption). This compares to a 32% share of RES in electricity generation in 2017, mostly wind (18%) and hydro (7%), with solar photovoltaic (PV), concentrated solar power (CSP) and biomass accounting for the rest.[3] The main goals of the auctions were effectiveness (*i.e.*, that the projects were actually built) and minimization of support costs, *i.e.* to comply with the 2020 targets at the lowest support costs in order to reduce the tariff deficit.

The design of the 2016-2017 auctions was strongly influenced by the particular features of the regulatory package approved in 2013/2014, including the existing electricity Law, which tried to ensure the financial stability of the electricity system and to contain the increasing tariff deficit in the previous years. This regulatory framework, which is quite complex and does not have an international precedent, is summarised in the following box and fully described in del Río *et al.* (2015c).

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1 In 2014, RES penetration was 17.3%, versus the expected indicative RES Directive trajectory (2-year averages) for 2013-2014, which is 12.1%. The 2020 target for Spain is 20%.

2 According to Eurostat, retail electricity prices in 2014 in Spain were as high as 235€/MWh for households, whereas the EU27 average was 205 €/MWh. However, retail electricity prices for industrial consumers were 141€/MWh for industrial consumers, slightly below the EU-27 average (149€/MWh).

3 According to REE (2019), the electricity mix in 2018 was: Combined cycle gas turbines (10.8%), coal (14.5%), nuclear (21.4%), wind (19.8%), hydro (13.7%), PV (3%), CSP (1.8%), other renewables (1.7%), cogeneration (11.6%) and other non-renewables (1.7%).

Box 1. The new regulation framework for RES-E implemented in 2013.

The 2013/2014 regulatory package was based on four pieces of legislation: a Royal Decree Law (RDL 9/2013), a Law (Law 24/2013), a Royal Decree (RD413/2014) and a Ministerial Order (Orden IET/1045/2014). RES-E plants would receive the market price plus a *"specific complementary remuneration"*, which has two elements, a remuneration for the investment and a remuneration for the operation of the plant:

- The remuneration for the investment (Rinv) refers to a payment per kW that allows installations to recover those investment costs which cannot be recovered by the sales of electricity in the market. This payment is received during the useful regulatory life of the installation.

- The remuneration for the operation (Ro) refers to a payment per kWh for those technologies whose operational costs are above the average wholesale electricity price.

The setting of both types of remuneration will be based on several items (for a plant type), *i.e.*, on the retributive parameters of each plant type. Each installation receives the market price plus the specific remuneration (Rinv + Ro) of the plant type taking into account that a *"reasonable profitability level"* cannot be exceeded. However, in the two auctions only the Rinv will be provided (not the Ro). Under this system, renewable energy operators are guaranteed a reasonable rate of return that is composed of the 10-year government bond plus a spread, which is set at 300 basis points (at least for the first regulatory period). This return is calculated on the asset base of a standardised facility over its lifetime, considering its investment costs, wholesale market income and operational costs during the regulatory lifetime. The standardised costs vary according to the technology and year of entry into operation, and are revised every six years, except for the initial investment value and the regulatory lifetime. The reasonable profitability for the first regulatory period is 7.5%.

Source: del Río et al. (2015c), IEA (2015).

The specific remuneration for the RES plants (Rinv) and the value of the initial investment were provided through the auctions in 2016 and 2017. The outcome of the auction was a discount on the standard value of the initial investment of the reference standard plant (RSP). This allowed obtaining the standard value for the initial investment of the standard plant (SP). From this last value, plus the rest of retributive parameters, the remuneration for the investment of the SP was obtained (applying the methodology set in RD 413/2014). The capacity allocated to each participant for each technology would result from the auction.

Although the 2013/2014 regulation applied to all electricity generation sources, the need to comply with the 2020 RES target led to the call for three RES auctions at short notice and without a previous schedule, one in 2016 and another two in 2017, all within the existing regulatory framework. In contrast, the 2021-2030 auctions will be organised in the context of a medium/long-term energy planning (the PNIEC, whose draft was submitted to the European Commission on February 22nd 2019), with a lower level of tariff deficit and a higher penetration of intermittent RES (which makes the need for flexibility, dispatchability and back up more acute). In the context of the Directive 2018/2001, the measures in the PNIEC will allow to achieve the following targets in 2030: a 21% reduction in GHG emissions with respect to 1990, a 42% share of RES in final energy consumption, a 39.6% improvement of energy efficiency and, most importantly for this paper, a 74% share of RES in electricity generation. The end goal is to reach carbon neutrality in 2050 and those targets are instrumental in achieving it. The PNIEC expects that, for 2030, an installed capacity of 157 GW will be deployed, of which 120 GW will be renewable (including pumping), up from 51 GW in 2015 (Table 1). The Plan expects that an additional capacity of 57 GW of RES-E will be installed during the 2021-2030 period. Accordingly, electricity generation from RES will more than double between 2015 and 2030 (from 9793 ktoe in 2015 to 21000 ktoe in 2030)[4] and its share in gross generation is expected to increase from 36% in 2015 to 76% in 2030. Auctions are envisaged as the main instrument for the deployment of the renewable electricity technologies.

Table 1. Evolution of the installed capacity in electricity generation (MW, 2015-2030).

	2015	**2030**
Wind	22925	50258
PV	4854	36882
CSP	2300	7303
Hydro	14104	14609
Pumping	6024	9524
Biogas	223	235
Geothermal	0	30
Marine energies	0	50
Biomass	677	1677
Cogeneration (with renewables)	585	515
Coal	11311	0
Gas	27531	27146
Cogeneration (with fossil fuels)	4684	3230
Fuel/gas	2790	2093
Solid urban wastes	234	234
Nuclear	7399	3181
TOTAL	**105641**	**156967**

Source: MITECO (2019).

It can be observed that the aim is to replace coal and (partly) nuclear with RES (especially PV and, to a lesser extent, wind).

Compared to the previous auctions, flexibility in dispatch and actor diversity are added to effectiveness and minimisation of support costs as the main goals of RES-E support (table 2). In particular, within actor diversity, a special emphasis is put on *"renewable energy communities"*. Social acceptability and regulatory stability (stability of revenues) are also mentioned as relevant goals, although the latter can be regarded as instrumental in minimizing support costs[5]. Minimisation of support costs continues to be an important goal in the PNIEC. According to the MITECO 2019 (p. 40), *"the design should prioritise these installations which facilitate a more efficient energy transition. All in all, the design of the remuneration system should minimise the insecurity due to their large-scale deployment in order to avoid an increase in the price of energy, due to: 1) a sharp reduction in the wholesale market prices; 2) the existence of spills at times of high renewable electricity generation; 3) an increase in social opposition due to the high concentration of projects in the locations with the best resources, together with an inefficient sharing of benefits. These goals influence the design of the auction."*

Regarding the procedure, the new design of the auctions, in the context of the elaboration of the PNIEC, seems to benefit from a more systematic public consultation process than the previous one. The previous auctions were criticized for the lack of considerable interaction with different types of stakeholders (including the renewable energy associations)(del Río 2016, 2017a, 2018). In contrast, the PNIEC has counted on the recommendations of *"a wide team of experts made up of staff from different departments of the Ministry for the Ecological Transition (MITECO) which, in turn, has relied on the technical assistance of academic and research centres with a wide experience and knowledge in the realms of economics, energy and climate change, as well as with the important collaboration of Red Eléctrica de España (the system operator). The working group has met once or twice a week during the seven months dedicated to the elaboration of the Plan"* (MITECO 2019, p. 19).

3. The new design of auctions for the 2021-2030 period: an initial analysis of design elements

This section describes the main design options already envisaged by the PNIEC for the auctions in the 2021-2030 period, compares them with the design choices made in previous auctions in Spain and with the international experiences[6] and provides a brief assessment, highlighting their pros and cons.

4 Notwithstanding, as argued in the Plan, the specific distribution per renewable energy technology between 2021 and 2030 will depend *"on their relative costs as well as their feasibility and flexibility in their implementation and, thus, their relative weight may change"* (MITECO 2019, p. 42).

5 *"The plan gives the necessary signals in order to provide certainty and a sense of direction for all actors. The design of the auctions is based on the predictability and stability of revenues when facing the decision to invest and its financing"* (MITECO 2019, p. 7).

6 An in-depth investigation of the design of auctions of 30 international experiences from around the world, with different temporal and technology scopes, was carried out in del Río (2017b).

Table 2. Goals in the PNIEC (additional to effectiveness and minimisation of support costs).

Goals in the PNIEC	Description
Actor diversity	Regulations will be passed in order to favour the diversity of actors and the existence of participatory citizen projects, promote social and territorial cohesion as well as the just transition and to benefit from the opportunities of the new decarbonised generation model (MITECO 2019, p.66). On the other hand, the plan encourages the development of self-consumption and local energy communities and, ultimately, a greater participation of citizens in the energy system (MITECO 2019, p.284). The PNIEC 2021-2030 proposes instruments and measures "to facilitate and reinforce the role of local energy communities and the emergence of new actors in the energy transition"(MITECO 2019, p.43). This in line with Directive 2018/2001, which states that Member States must assess the barriers and potential for the development of renewable energy communities. Article 1 of the Directive defines "renewable energy community" as a legal entity: (a) which (...) is based on open and voluntary participation, is autonomous, and is effectively controlled by shareholders or members that are located in the proximity of the renewable energy projects that are owned and developed by that legal entity; (b) the shareholders or members of which are natural persons, SMEs or local authorities, including municipalities; (c) the primary purpose of which is to provide environmental, economic or social community benefits for its shareholders or members or for the local areas where it operates, rather than financial profits.
Flexibility of dispatch	The massive deployment of renewable energy generation makes it necessary to plan its integration in the system. The old paradigm of base-load and peak generation has been transformed into a new one of variability versus flexibility. The PNIEC ensures the flexibility of the system, allowing that demand-side management and storage contribute to the security (and quality) of supply and reducing the dependence on fossil-fuel thermal plants as a back-up mechanism" (MITECO 2019, p.42).

Source: MITECO (2019).

3.1 Medium/long-term RES-E targets

A critical aspect, and certainly a main difference with respect to past auctions, is the existence of a RES-E target in a medium/long-term timeframe (74% of RES in electricity generation in 2030). This contrasts with its absence in the 2020 timeframe. The PNIEC even identifies the amount of additional RES-E installed generation capacity which is envisaged for the period 2021-2030 (57GW). This can be regarded as the maximum volume to be auctioned throughout the period. Those volumes, mostly of PV and wind on-shore (*see* Table 1) are substantial with respect to the existing installed capacities (especially for PV).
In contrast, the previous auctions were ad-hoc ones (*i.e.,* without prior notice). They were not organized in the context of a long/medium term planning with RES and RES-E objectives in mind. Only the 2020 (*i.e.* short-term) RES target for Spain was established. It is true that an Energy Planning document (Plan for the Development of the Electricity Transport Grid 2015-2020), approved by the Ministry of Industry, Energy and Tourism in 2015, envisaged that RES would experience the main increase in 2013-2020 among the electricity generation technologies (8535 MW). However, this plan was not binding in the same manner as the PNIEC is.

Setting medium to long-term RES and, specially, RES-E targets is important for potential investors and bidders. They provide a signal on potential volumes and thus increase the level of confidence in the auction, may reduce sunk costs (since some of these costs, for example administrative permits, are partly recoverable if they participate in successive auctions) and also benefit the supply chain (*e.g.* equipment manufacturers can plan their investments accordingly).

3.2. A schedule of regular auctions

Another important feature of the new auctions is the existence of a schedule. The government will publish a multiannual schedule of auctions for the 2021-2030 period *"which aims to provide* *predictability and stability of revenues in order to facilitate investment and financing decisions"* (MITECO 2019, p. 66). A schedule of auctions was missing in the previous auctions. The exact date of the three auctions (January 2016, May and July 2017) was known only a few months before their celebration. Even their mere occurrence could not be anticipated.

The existence of regular rounds with a schedule is usually deemed a best practice. The alternative is stand-alone auctions, *i.e.,* set at irregular intervals. However, the international evidence on the existence of a schedule for auctions is mixed. Somehow strikingly, most countries analysed in del Río (2017b) did not have it and ad-hoc auctions have dominated (in 19 out of 30 auctions). This is in spite of the widespread opinion that a schedule of auctions is beneficial for different reasons. It is usually considered that it decreases investor risks, improves financing conditions and encourages participation in the auction. Furthermore, the expectation that there will be more rounds mitigates the risk of underbidding since bidders do not need to bid so aggressively in a given round, with a positive impact on effectiveness. In addition, a schedule facilitates the development of a robust supply chain because equipment manufacturers can plan their investments accordingly (del Río and Linares 2014). However, stand-alone auctions would allow governments to retain flexibility to adjust the auctioning schedule due to changes in market conditions (IRENA 2015). This might be the reason why they are more widespread. Overall, the choice of this design element seems to be coherent with the government goals as defined in the PNIEC.

3.3. Generation-based volume

A main change in design refers to the setting of the volume and the product being auctioned. There are three main metrics to set the volume in an auction: capacity, generation or budget. In a capacity-based metric, a total quantity in terms of MW is auctioned. With auction volumes defined in terms of electricity generation, a total amount of MWh is offered up for bidding. Finally, under a budget-based metric, an overall amount of support is provided (del Río 2017b). According to the draft PNIEC (MITECO 2019, p. 66), generation will be auctioned (MWh) in future auctions in Spain, *"unless a change in market conditions"* requires otherwise. This is in sharp contrast to the three auctions which were organised in this country, in which the auction volume was defined in terms of RES-E generation capacity (MW) and also in contrast to the international experiences, where a generation-based metric to set the volume of the auction as well as the product being auctioned is quite exceptional. Capacity-based targets are the almost unanimous choice around the world. Of the 30 experiences analysed in del Río (2017b), only Peru and Chile exclusively use this metric, and other 3 countries combine it with either a capacity-based metric (Mexico and Panama) or with a budget-based one (Poland).

Compared to other alternatives to set the volume in the auction, a generation-based metric has a main advantage: it provides a good planning environment for the electricity sector (grid management) and enables monitoring regarding the achievement of RES targets, especially if these are formulated as a share of electricity generation since a level of generation cannot be ensured under capacity-based targets. However, due to the fluctuating availability of PV and wind generation (natural variation in weather conditions), it is more difficult to set and reach definitive targets (Schenuit *et al.* 2018, p. 13). Furthermore, this metric makes it more difficult to assess target compliance early, as it is necessary to wait until the end of the remuneration period, which is not the case with the other two metrics. In particular, with a generation-based metric, uncertainty on the total support costs is greater than with budget-based volumes, but lower than with capacity-based volumes (if support is provided to electricity generation). Finally, generation-based targets provide a slightly worse signal to equipment manufacturers on the relevant market size for the future than capacity-based targets (del Río *et al.* 2016).

3.4. Price-based support

In theory, remuneration in an auction can be provided as a price for the electricity generated (€/MWh) or as support for the investment in electricity-generation capacity (€/MW). In future auctions, bidders will offer a given price for the electricity generated. This contrasts sharply with past auctions, when participants bid for a given reduction percentage in the investment-based support. The choice for generation-based remuneration is in line with the international experience (27 out of 30 countries in del Río 2017b). According to del Río (2017b), in addition to the previous three auctions in Spain, only Russia and California have applied a capacity-based remuneration metric. An scheme which provides investment-based remuneration gives a lower incentive to deploy the plants in the sites with the best renewable energy resources (wind, solar radiation...) and to run the plant efficiently. A generation-based metric leads to lower certainty on the total support costs than a capacity-based metric because support is paid up-front in this latter case.

3.5. Technological diversity: Technology-specific auctions

Policy-makers may be willing to introduce design elements which increase diversity with respect to technologies, locations, actors and sizes of the installations for a number of reasons (*see* del Río *et al*. 2015b for an extensive explanation). Diversity could be promoted in an auction by organizing different auctions per alternative (*e.g.,* technology-neutral vs. technology-specific), by including minimum quotas per alternative, by providing different remuneration levels for different alternatives or by lowering prequalification requirements or introducing penalties for specific categories, *i.e.*, small actors (del Río 2017b).

Regarding technological diversity, a main distinction is between technology-specific auctions (in which only one technology is eligible to participate in each auction), multi-technology auctions (in which several but not all renewable energy technologies may participate in the auction) and technology-neutral auctions (in which all renewable energy technologies are eligible to participate and compete between each other). The possibility to organize technology-specific auctions is included in the PNIEC *"it will be possible to distinguish between the different electricity generation technologies as a function of their technical characteristics, levels of dispatchability or capacity to guarantee firm capacity and criteria related to location, technological maturity and those which guarantee the transition towards a decarbonised economy"* (MITECO 2019, p. 66). For mature technologies, either technology-specific or technology-neutral auctions can be organised, given that *"they have the potential to achieve high energy contributions, minimizing the amount of public support"* (MITECO 2019, p. 66).
Support for immature technologies will be awarded in technology-specific auctions. Two of these technologies *"which have not reached the stage of technological maturity"* are mentioned (marine energies and wind off-shore in deep waters). Technology-specific auctions for these technologies are justified, given that *"it is necessary to adapt the public support schemes to the peculiarities of each technology or the different territories (especially non-mainland ones) in order to take into account that they are not yet able to compete in terms of generation costs but entail an added value for the electricity system because they diversify technologies, energy sources and locations, as well as their future development potential"* (MITECO 2019, p. 66). For these technologies, a specific schedule of auctions with a reduced capacity volume is proposed in order to accommodate demonstration or flagship projects (MITECO 2019, p. 67). Interestingly, complementing the auction with other instruments is also considered since *"depending on the specific needs of each case the auction could go together with public financing"* (MITECO 2019, p. 67).

In addition, auctions may be used for specific technologies (*e.g.,* dispatchable) and also for repowering. Regarding the former, auctions for non-fossil fuel, firm back-up capacity address the broader concern on flexibility of dispatch with a high penetration of intermittent RES. Dispatchable technologies (in particular, CSP with nine hours of storage and biomass) may fulfil this concern, but also batteries for energy storage. The PNIEC mentions that *"there might be calls for auctions in which the product to be auctioned is the inclusion to the electricity system of firm back-up capacity of technologies which do not entail the use of fossil fuels, even if they do not involve an increase of electricity generation capacity by themselves, such as batteries. In this case, the variable on which offers are provided would be the additional annual remuneration per unit of firm capacity (MW) or storage capacity (MWh)"* (MITECO 2019, p. 68). *"Those batteries will represent an equivalent capacity of about 2.5 GW in 2030, with a minimum of two hours of storage at maximum load"* (MITECO 2019, p. 68).

On the other hand, the auctions in the PNIEC will explicitly encourage repowering. The possibility to use the auctions to boost repowering was excluded in the second and third auctions in 2017, although it was envisaged in the first one. Repowering-specific auctions will be organized for the *"technological renovation of RES installations which have exceeded their useful regulatory life"* in order to avoid a reduction of RES installed capacity (MITECO 2019, p. 76). It is expected that this will be the case with around 22 GW of RES in the 2021-2030 period (mostly wind and hydro plants). The awarded projects will receive a premium on top of the market price. These projects will also benefit from a multiannual schedule of auctions.

The three previous auctions in Spain have been of all sorts: technologically-neutral (May 2017), multi-technology (only for wind and solar PV, July 2017) and technology-specific (wind and biomass, January 2016).[7] The choice for technology-specific auctions is in line with most auctions worldwide (23 out of 30 auctions in del Río 2017b are technology-specific ones).

There are some pros and cons of this choice. On the one hand, technology-differentiated support aims to promote a wider diversity of technologies, which would be beneficial for the less mature technologies and may provide several benefits for the country doing it in terms of a diversification of energy sources, encouragement of a local industrial value chain and, probably, better system integration (given this diversity and the promotion of dispatchable technologies). On the other hand, in general, a problem with increasing diversity in RES-E auctions is market segmentation, which could lead to few bidders and low competition in a given auction. Technology-neutral auctions could be expected to lead to stronger competition than technology-specific auctions due to a potentially higher number of participants. Projects with lowest costs would be awarded a contract and (direct) generation costs would be minimised (del Río 2017b). However, a technology-specific auction could reduce support costs. The reason is that in such auctions support levels can be differentiated per technology, thus reducing profits for the cheapest technologies. The support levels would be more adapted to the costs of the different technologies, in line with the principle of third degree price discrimination (Mora *et al.* 2017, p. 24).

The need to organise auctions for dispatchable technologies (including storage) deserves a special mention. Renewables, especially variable renewable technologies, cause indirect costs. These include balancing costs (due to deviations from schedule of variable RES-E power plants and the need for operating reserve and intraday adjustments in order to ensure system stability), profile costs (mainly back-up costs, *i.e.,* additional capacity of dispatchable technologies required due to the lower capacity credit of non-dispatchable RES-E) and grid costs (related to the reinforcement or extension of transmission or distribution grids as well as congestion management) (Breischoft and Held 2013). At increasing shares of renewable electricity, policy makers have a growing interest to ensure a low cost integration of renewables into their energy system by steering the geographical distribution of RES installations, the timing of their generation, or by subjecting them to forecasting and balancing requirements (Steinhilber and Rosenlund 2016). The value of electricity depends on when, where and how it is generated, especially in electricity systems with a high penetration of intermittent RES-E. Given certain periods, an abundance (scarcity) of RES-E generation may coincide with a relatively low (high) demand. In these cases, the value of electricity is low (high) (OCDE/IEA 2016). Ignoring such variability underestimates the costs of intermittent RES-E generation in the electricity system, especially with high penetration levels (Edenhofer *et al.* 2013).

Therefore, the (higher) value of the electricity generated for the electricity system is important, as it is a (lower) price/cost (LCOE), and the relevance of such value (*i.e.,* providing flexible dispatch) increases with the increased penetration of intermittent RES-E. Price-only auctions may award contracts to the cheapest bidders in terms of lower LCOE, but not necessarily in terms of lower system costs (value of electricity). Interestingly, some auctions explicitly include the *"value"* of electricity in their design, trying to encourage electricity generation at times of higher demand (Mexico, California and Abu Dhabi). Rewarding dispatchability (flexible dispatch) can be done in several manners, for example through the

7 However, although all the technologies were eligible to participate in the May 2017 auction and, in theory, they could have competed against each other, it is doubtful that it can be really termed a "technology neutral" auction, as the government did, given the way that the supply curve was built and the rules to select the winner in case of equal bids (favouring wind on-shore vs. PV)(see del Río 2017a for a detailed explanation).

introduction of time-of-day signals (as in Mexico), by requiring a given dispatch from the start in the prequalification requirements (*i.e.,* obligation to dispatch from 4 pm to 10 am., as in Dubai), or by rewarding dispatch at a given time (*i.e.,* a support multiplier for dispatching at peak hours, as with CSP in South Africa)(del Río and Mir-Artigues 2019). It can also be done by organizing specific auctions in which only dispatchable technologies can participate (*i.e.,* leading to the lowest LCOE among the dispatchable technologies).

3.6. Actor diversity: participatory citizen projects

Actor diversity is an explicit policy goal in the PNIEC (*see* Table 2). In particular, given their social benefits "participatory citizen projects (PCP)" are emphasized and a quota is set for them. It is unclear at this stage, however, whether auctions will be used to encourage actor diversity in general and PCPs in particular. The idea seems to be to promote these projects with another support scheme (*i.e.,* a PPA whose level of remuneration is linked to the outcome of the auctions). As argued in the PNIEC, *"PCPs have additional advantages, such as a greater socioeconomic impact and they increase social acceptability and awareness on the benefits of RES"* (MITECO 2019, p. 66). Therefore, a minimum share of investments in RES projects which should be open to the participation of people or institutions from the municipality where the projects are located, so that they can be co-owners or co-investors, can be set. Furthermore, a mechanism (Mecanismo de Adhesión) can be established in order for PCPs to access an electricity sales contract at a fixed price which is linked to the outcome of the auction. In addition, public guarantees might be implemented to ease their financing. An annual quota for PCPs will be set aside and they will be granted on a first-come-first-served basis. Thus, a favourable treatment of these projects is envisaged, but not necessarily auctions for PCPs as such.

In most countries, actor diversity is not an explicit government goal. Therefore, auctions are most often actor-neutral, *i.e.,* no special provisions for small actors are included (del Río 2017b). One main exception is Germany, where auctions aim to fulfil three main objectives (Schenuit *et al.* 2018, p. 22): Control and steer the expansion volume, decrease policy support costs by competitive price determination and achieve a high level of participation and diversity of bidders. Although it is not an explicit government goal, some countries support small actors. Out of the twelve auctions from around the world reviewed in Wigan *et al.* (2016), only France and Ireland, in addition to Germany, explicitly considered the needs of smaller actors.

Although larger installations facilitate economies of scale in production, which would lead to lower generation costs, there are several reasons to promote actor diversity: increasing social acceptability of renewable energy technologies and the scheme used to support them (*e.g.,* auctions), diversifying the risk of target default, exploiting RES-E potentials,[8] lowering the risks of collusion and increasing the competition in the auction. Small actors suffer proportionally more than large actors from risks (probably higher risks and more difficulty to cope with those risks) and usually have higher generation costs and transaction costs of participating in the auction. Thus, facilitating their participation in the auction with special provisions or supporting them with a non-auction scheme (as allowed in the EU by the Guidelines on State Aid for Environmental Protection and Energy 2014-2020) are two reasonable alternatives if actor diversity is a policy goal.[9]

3.7. Geographical diversity: auctions in non-mainland territories

A specific scheme is envisaged for RES in non-mainland territories (mostly islands). This is justified because: 1) the electricity systems in these territories are subject to a particular regulation, conventional back-up technologies are being used to a greater extent and the costs of generation are higher there; 2) investment and operation costs are higher in those territories than in mainland ones

8 Different investor types address different parts of the overall potential of a technology. Thus, for example, utilities might focus on large wind farms, whereas local communities might invest in individual wind turbines (Fraunhofer ISI *et al.* 2014).

9 Several alternatives to encourage the participation of small actors in the auction include reduced financial pre-qualification for small actors, reduced material pre-qualifications (building permits, grid access,...), differentiation of pricing rules for small and large actors, exemption of small actors from auction scheme, contingents and boni for small actors (see del Río *et al.* 2015a and Steinhilber and Rosenlund 2016).

Table 3. Summary of the comparison of the PNIEC auctions, previous auctions in Spain and international experiences.

DESIGN ELEMENTS		**PNIEC 2021-2030**	**Past RES-E auctions in Spain (2016-2017)***	**International experiences****
Category	**Options**			
1. Volume	Generation (GEN), budget (BUD) or capacity-based (CAP)	GEN	CAP	Overwhelmingly CAP
2 Periodicity (schedule)	Yes (Y)/No (N)	Y	N	Mostly N
3 Diversity	Technology-neutral (TN), multi-technology (MT) and technology-specific (TS)	TN (mature), TS (mature and less mature, inc dispatchable and storage)	TN (May 2017), MT (July 2017), TS (Jan. 2016)	Mostly TS
	Geographically-neutral (Y/N)	Y (mainland and also specific to non-mainland territories)	Y (only peninsular, but specific regime for islands).	Mostly Y
	Actor diversity (Y/N)	Y (promotion of participatory citizen projects)	N	Mostly N
4 Support condition	Type of remuneration (capacity (CAP) vs. generation (GEN))	GEN	CAP	Overwhelmingly GEN
5 Selection criteria	Price-only vs. multicriteria.	Price-only	Price-only	Mostly price-only
Other:	Treatment of repowering	Repowering auctions	Repowering not allowed in 2nd and 3rd auctions, but allowed in 1st auction.	N.A.

*See del Río (2017a, 2018) for further details ** As analysed in del Río (2017b).*

and, thus, they could not compete in a level playing field in a geographically-neutral RES auction (MITECO 2019, p. 67). Auctions might be used in these territories to promote RES in the 2021-2030 period. This is not a radical deviation from the past, however.

Although the aforementioned three auctions in Spain (in 2016 and 2017) were only for locations in the mainland territory, a specific scheme for RES auctions applied in the Canary Islands.

Although most countries have adopted geographically-neutral auctions (see del Río 2017b), a policy maker may want to steer the geographical distribution of awarded projects and favour a given area (region) in an auction for a number of reasons: *i.e.* avoiding the creation of hot-spots, coordinating RES deployment with the existing grid and with grid expansion plans, reducing producer rents, or for political or social acceptability reasons (Steinhilber and Rosenlund 2016). In the Spanish case, the territorial differentiation seems justifiable, given the specific characteristics of non-mainland regions.
The following table summarises the aforementioned discussion on the comparison between the different auctions in Spain and the international experiences.

Notwithstanding, many design elements of the future auctions in Spain are undefined at the time of writing and they will be determined in subsequent relevant legislation (royal decrees and ministerial orders). Among others, these include the auction format (single-item vs. multiitem), auction type (static, dynamic and hybrid), pricing rules (pay-as-bid *vs.* uniform), form of remuneration (feed-in tariffs, sliding or fixed feed-in premiums), ceiling prices, realisation period (deadlines for construction), prequalification requirements and penalties.

4. Conclusion

Auctions are not an end in themselves, but an instrument used by policy makers to comply with their energy policy goals and targets, given a socioeconomic and institutional context. Therefore, their design is likely to reflect these goals and context as well as policy learning with respect to previous domestic and international experiences. This can be observed in the rationale and main design elements of the auctions envisaged in the draft PNIEC for the 2021-2030 period in Spain. In addition to effectiveness in deployment and minimization of support costs (which were explicit goals in the previous auctions), actor diversity and flexibility of dispatch (system integration) appear to be major goals in the design of the future auctions.

It can be argued that the main design choices of the future auctions in Spain entail a rupture with the auctions organized in the past in this country. In general, they are less complex and are more aligned with the international experiences. Learning from those international experiences may have influenced those choices. The design elements entail a change in philosophy in some respects. In particular, organizing auctions within a medium and long-term energy planning strategy and a multiannual schedule, auctioning and remunerating generation and not capacity and explicitly promoting technological and actor diversity imply a substantial change with respect to previous auctions and are deemed appropriate choices, taking into account the aforementioned goals.

However, it is obviously too early to assess the success of the design elements selected to achieve those goals and this judgement should be the focus of future research. Furthermore, many details on the design elements are unknown at the time of writing and will be decided and included in future legislation.

References

- Breitschopf, B., Held, A. 2013. *Guidelines for assessing costs and benefits of RET deployment. Report in the framework of the EU-funded DIACORE project.* http://diacore.eu/
- Del Río, P. 2016. *Implementation of Auctions for Renewable Energy Support in Spain: A case study.* Report of the EU-funded project AURES D7.1-ES, March 2016. http://www.auresproject.eu/publications/implementation-of-auctions-renewable-energy-support-in-spain
- Del Río, P. 2017a. “Designing auctions for renewable electricity support: the case of Spain”. *Renewable Energy Law & Policy Review,* Volume 8, Number 2, 23-37(15).
- Del Río, P. 2017b. Designing auctions for renewable electricity support. Best practices from around the world. *Energy for Sustainable Development* 41, 1-13.
- Del Río, P. 2018. An analysis of the design elements of the third renewable energy auction in Spain, *Renewable Energy Law & Policy Review,* Volume 8, Number 3, May 2018, pp. 17-30(14).
- Del Río, P., Janeiro, L. 2016. Overcapacity as a Barrier to Renewable Energy Deployment: The Spanish Case. *Journal of Energy,* 1-16
- Del Río, P., Linares, P. (2014). Back to the future? Rethinking auctions for renewable electricity support. *Renewable and Sustainable Energy Reviews* 2014; 35: 42-56.
- Del Río, P. and Mir-Artigues, P. 2019. Designing auctions for concentrating solar power. *Energy for Sustainable Development* 48, 67-81
- Del Río, P., Haufe, M.C., Haufe, Wigan, F., Steinhilber, S. 2015a. *Overview of Design Elements for RES-E Auctions.* Report D2.2 (a) of the EU-funded project AURES. October 2015 http://www.auresproject.eu/publications/overview-of-design-elements-res-e-auctions
- Del Río, P., Wigan, F., Steinhilber, S. 2015b. *Assessment criteria for RES-E Auctions.* Report of the EU-funded project AURES D2.2 (b). http://www.auresproject.eu/publications/assessment-criteria-res-e-auctions
- Del Río, P., Iglesias, G., Calvo, A. 2015c. The New Renewable Electricity Support Scheme in Spain: A Comment. *Renewable Energy Law and Policy* 6(1), 17-24
- Del Río, P., Rosenlund, E., Steinhilber, S. 2016. The effect of award types on auction outcomes. Report of the EU-funded project AURES.

Policy memo 3. http://www.auresproject.eu/publications/the-effect-of-award-types-on-auction-outcomes
- Edenhofer, O., Hirth, L., Knopf, B., Pahle, M., Schlömer, S., Schmid, E., Ueckerdt, F. 2013. On the economics of renewable energy sources. *Energy Economics* 40, S12-S23.
- Fraunhofer ISI *et al.* 2014. *Auctions for Renewable Energy in the European Union: Questions Requiring further Clarification*. Study on behalf of Agora Energiewende. www.agora-energiewende.de
- International Energy Agency 2015. *Energy Policies of IEA Countries 2015 Review. Spain*. Paris.
- IRENA 2015 Renewable Energy Auctions: A Guide to Design.
- Ministerio para la Transición Ecológica (MINECO) 2019. *Borrador del Plan Nacional Integrado de Energía y Clima 2021-2030*.
- Mora, D. Kitzing, L., Rosenlund Soysal, E., Steinhilber, S. Del Río, P. *et al.* 2017, *Auctions for renewable energy support – Taming the beast of competitive bidding.* Report of the EU-funded project AURES. Report D9.2, December 2017. http://auresproject.eu/sites/aures.eu/files/media/documents/aures-finalreport.pdf
- OCDE/IEA 2016. Next generation wind and solar power. From cost to value.
- Red Eléctrica de España (REE) (2019). *Avance del Informe del sistema eléctrico español 2018*. https://www.ree.es/es/estadisticas-del-sistema-electrico-espanol/informe-anual/avance-del-informe-del-sistema-electrico-espanol-2018
- Schenuit, D. *et al.* 2018. *The Economies of support policies for renewables. Money well spent.* GIZ.
- Steinhilber, S., Rosenlund, E. 2016. *Non-price criteria in auctions Policy Memo of the EU-funded AURES project,* October 2016.
- Wigan, F., Förster, S., Amazo, A., Tiedemann, S. 2016. *Auctions for renewable energy support: lessons learnt from international experiences*. Report D4.2 of the EU-funded AURES project, June 2016.